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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : H04Q 7/00, G08B 5/22 — A1

(11) International Publication Number: WO 91/11889

(43) International Publication Date: 8 August 1991 (08.08.91)

(21) International Application Number: PCT/US91/00731

(22) International Filing Date: 4 February 1991 (04.02.91)

(30) Priority data:
473,791 2 February 1990 (02.02.90) US

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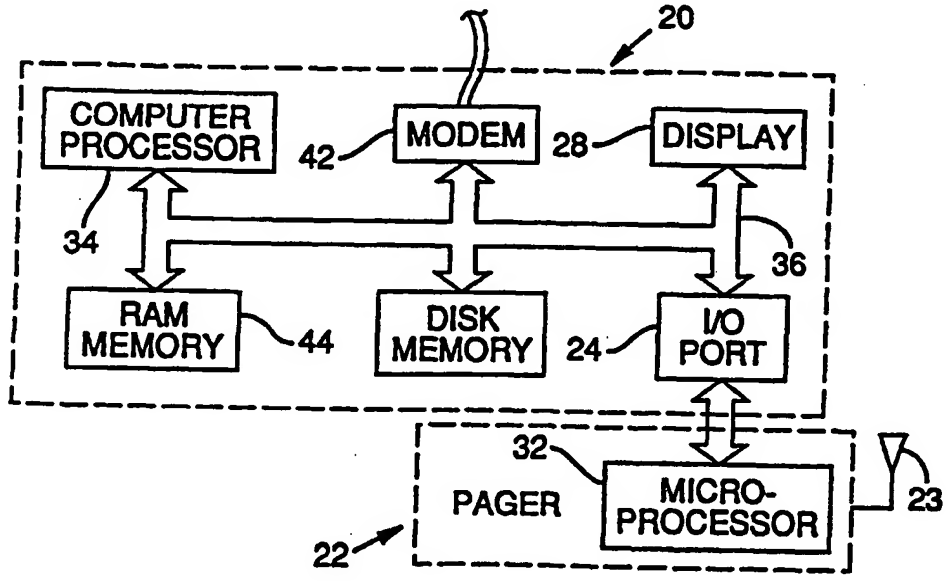
(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: PAGER EQUIPPED COMPUTER



(57) Abstract

An improved personal computer (20) includes an interface (24) to a paging receiver (22), thereby providing, among other advantages, remote communication and control capabilities not heretofore known in either the paging or computer arts.

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PAGER EQUIPPED COMPUTER

Related Application Data

The present application is a continuation-in-part of copending application Serial No. 07/356,630, filed May 30, 1989, which is a division of Serial No. 06/802,844, filed November 27, 1985, now U.S. Patent 4,713,808, and is also a continuation-in-part of copending application Serial No. 07/326,491, filed March 17, 1989, which is a continuation of Serial No. 07/101,252, filed September 25, 1987 and now abandoned, which is a division of Serial No. 06/802,844, filed November 27, 1985, now U.S. Patent 4,713,808.

Field of the Invention

The present invention relates to radio paging systems, and more particularly to the combination of such paging systems with personal computers.

Background and Summary of the Invention

Personal computers are important and widely used tools in our society. Many personal computer have communication capabilities such as modems or connections to LANS (i.e. local area networks). Furthermore some computer modems have the capability of communicating by radio signals.

Radio paging systems are also important and widely used systems in our society. A radio paging system is a specialized type of communication system which is designed to alert an individual that someone is seeking

to contact them. Such systems are relatively low cost and they generally communicate short messages in only one direction with no automatic acknowledgement capability. An example of a radio paging system is shown in U.S. Patent 4,713,808 (Gaskill) which is assigned to the assignee of the present invention.

The capabilities of traditional personal computers and traditional radio pagers have not heretofore been exploited in tandem. The present invention advantageously couples these two technologies and in so doing, provides a number of important features not previously achieved in either the personal paging or computer arts.

In todays society, many people spend long hours watching the screens of their personal computer. Combining a radio paging network with a personal computer provides a very effective means of communicating paging messages to such people.

Summary of the Invention

In accordance with the present invention, a personal computer (either desktop, laptop, or notebook) is provided with a paging receiver. The pager enhances the computer's general purpose utility by providing it with a means of receiving short messages without unduly burdening the computer with overhead housekeeping operations. The computer likewise enhances the pagers utility by providing a means for displaying paging messages on the screen where an operator will readily see them and by providing logging and acknowledgement capability. The combined system can provide new features, such as audit trails, multi-address paging reception, and dial-up feedback to the originating paging system, that have previously been unknown in the personal paging art.

The foregoing and additional features and advantages of the present invention will be more readily apparent from the following detailed description thereof, which proceeds with reference to the accompanying drawings.

Brief Description of the Drawings

Fig. 1 is a schematic diagram of a paging system employing a pager equipped computer according to one embodiment of the present invention.

Fig. 1A is a diagram of one of the printed circuit plug in cards in the personal computer shown in Fig. 1.

Fig. 2 is a schematic block diagram of a paging receiver used in the pager equipped computer of Fig. 1.

Fig. 3 is a schematic block diagram illustrating the pager equipped computer of Fig. 1.

Fig. 4 is a flow chart illustrating operation of interfacing software used in the pager equipped computer of Fig. 1.

Fig. 5 is a map of RAM memory used in the personal computer of Fig. 1.

Detailed Description

Applicant hereby incorporates by reference the disclosures of US Patents 4,897,835, 4,893,341, 4,885,802, 4,870,372 and 4,713,808, each of which is owned by the present assignee and relates to a paging system (the "Gaskill system") with which the present invention is illustrated.

Referring to Fig. 1, the illustrated paging system 10 includes a clearinghouse 12, a plurality of transmitter stations 14, a plurality of wristwatch paging receivers 16, and one or more pager/computers 18. As described in the previously referenced patents, the clearinghouse 12 is a automated centralized facility which accepts telephone messages, validates customer identification, determines message destinations, and routes messages to

the appropriate transmitter stations for transmission. Callers to the system dial a local clearinghouse telephone number and hear voice prompts which guide them through a simple process for sending messages. Each transmitter station 14 in the illustrated embodiment is an FM radio station that modulates paging signals on a subcarrier of its broadcast signal, as detailed in the above-referenced Gaskill patents.

The paging receivers 16 are wrist mounted devices which include radio paging circuitry in a case which has a wristwatch form factor. An important aspect of a paging system is that the paging receiver should be located so that the display can be viewed easily and often. Locating the paging message display in a wristwatch and in the screen of a prsonal computer satisfies this requirement.

Each pager/computer 18 comprises a conventional personal computer 20, which has a special card plugged into its bus. The additional card 22A is shown in Figure 1A. Card 22A has a series of contacts 22C which fit into a standard PC bus slot and a standard holding bracket 22D. Card 22A has mounted thereon a paging receiver of the type described in the above reference patent application. Standard interface circuity 24 connects circuit 22 to the appropriate power and data interface pins in connector 22C and provides the other standard interface circuitry needed by a PC plug in card. Paging receiver 22 receives

radio signals over an antenna 23 which extends outside the PC's metal case.

Personal computers 20 are well known in the art and are available from a variety of vendors, including IBM, Apple and Compaq. The computer 20 in Fig. 1 is illustrated with an associated screen display 28 that includes a window 30 in which paging messages may be presented. It should be noted that a personal computer is a fundamentally different device than what is often termed a microprocessor. A personal computer generally includes a microprocessor, but a personal computer is a device that includes in addition to a microprocessor, a memory system, I/O for alphanumeric textual material, and an operating system for handling alphanumeric textual material and commands.

As described in the above referenced patent, paging receiver 22 is highly miniaturized and it could be mounted directly to the rear panel of the computer rather than being mounted on a separate card. The only evidence that the computer 12 includes a pager would be a small antenna 23 extending therefrom. The paging receiver 22 includes a small microprocessor 32 to implement the pager's repertoire of functions. In the present embodiment processor 32 is dedicated to control of the pager circuitry.

Interfacing of the paging receiver 22 to the computer 20 is effected by a hardware interface 24, which is

recognized and controlled by an associated software routine 26 (Fig. 5). The hardware interface can be one of two types. In the first type, the interface connects the paging receiver directly to the system bus 36 of the personal computer. Such an implementation is desirable if the paging receiver is included as an integral part of the computer, rather than as a peripheral. In the second type, (not shown) the interface connects the paging receiver to one of the computer's external I/O ports. Interface through an external I/O port eliminates the need for any dedicated interfacing hardware. Rather, the interfacing hardware is the computer's own I/O card.

Fig. 4 illustrates, in flow chart fashion, an illustrative software interfacing routine 26 that may be executed on the computer 20 to interface the paging receiver 22. The details of illustrative paging receivers 22 and their control microprocessors are described in the above-referenced patents and are not repeated here. Similarly, the basics of interfacing peripheral devices through I/O ports of personal computers are also well known in the art and well described in the literature.

Routine 26 is an interrupt service routine that is invoked by the computer's processor 34 in response to an interrupt request signal issued by the pager to the computer's I/O port 24. The pager can issue an interrupt request signal in response to a number of events, most usually the receipt of a paging message. In response to such an

interrupt signal, the computer processor 34 saves its current machine state and associated pointers in registers and executes the routine 26.

As can be seen from Fig. 4, the illustrated interrupt routine 26, once invoked, causes the computer's processor to read an instruction word (4-bits) provided to the I/O port by the pager. This instruction word is composed by the pager microprocessor in accordance with the operation it wants the computer's processor to perform, as detailed more fully below. The routine 26 examines this instruction word and serially compares it against its sixteen possible values. When a match is found, the computer processor 34 has identified what function has been requested and invokes a corresponding one of a plurality of service routines A, B, C, etc.

The particular steps executed by service routines A, B, C, etc. depend on the desired functionality of the pager-equipped computer. The following discussion details a few illustrative functions.

In a first function, the pager can invoke the large data storage capacity of the computer to compile a historical audit trail of all paging messages directed to one (or more) paging addresses. In the illustrated embodiment, this function is invoked by the pager issuing an interrupt request to the computer and providing the instruction word '0001' to the I/O port each time a new message is received by the pager. (The pager already has

the capability to energize a "message waiting" annunciator on its display when a message is received, and the signal driving this annunciator can be provided to the least significant bit of the instruction word bits on the I/O port to yield the '0001' instruction word.)

In response to this '0001' instruction, the computer processor can open a disk file containing a chronological compilation of all messages received to date and can provide back to the pager processor a signal instructing it to provide the newly received message, one ASCII character at a time, through the I/O port. This data, which may include a date and time tag, are added to the disk file. When an end-of-field character is encountered among the data, the computer processor closes its disk file and resumes its normal operation. Desirably, the computer signals the response of a new message with a screen icon or a beep to the user.

According to this aspect of the invention, the user may, at his convenience, review newly received messages, or may review earlier messages archived in the file. Such a feature provides a backup capability in case the user's usual pager misses a page for any reason, and also provides an archival backup in case the contents or the existence of a page ever become an issue.

In a second function, the pager can invoke the display capabilities of the computer to display messages as they are received. Such a function is especially useful for

long messages, which may be somewhat tedious to review word by word on a wristwatch pager's limited display. This function is performed similarly to the audit trail function but, instead of writing the data to a disk file (or in addition thereto), the computer, on command, presents a window on the computer screen and displays the text in the window. (The presentation of a window on a display is well known in the computer arts and is illustrated, for example, in U.S. Patents 4,868,765, 4,862,389, 4,860,247, 4,860,218, 4,839,805, 4,823,108, 4,794,386, 4,769,762, 4,769,636, 4,633,415, 4,555,775 and 4,481,603, the disclosures of which are incorporated herein by reference.)

In a related embodiment, a line at the bottom of the screen is dedicated at all times to display of the most recent message, and includes an indication of the total number of pages received in the past 24 hours. By this arrangement, the user is constantly "on-line" and monitoring transmissions as they occur.

In one embodiment, the originating paging system 12 can be informed that a particular user has a computer available to display long messages. In such case, rather than having the user's wristwatch unit receive and store lengthy messages, the originating system can instead transmit the message with a datum that indicates the message is to be received and stored by the computer only. The system can send to the wristwatch pager a

different message indicating that a lengthy message has been sent to the user's computer.

In a third function, which may optionally be performed in tandem with any of the foregoing functions, the computer may check to insure that no messages have been missed. In the preferred embodiment of the Gaskill paging system, each message is sent with a consecutive message number. As these messages are transferred to the personal computer, the computer checks that the message number of each newly received message follows in sequence with the immediately preceding message. If the computer notes that message 4 is followed by message 6, it deduces that message 5 has been missed. In response to this determination, the computer presents an advisory notice to the user on the computer display. In a more sophisticated embodiment, the computer executes a communications program that telephones a paging control station 12 using an associated modem 42 and sends a scripted series of commands to the system into which the number of the missing page has been inserted. This script causes the paging system to rebroadcast the missing message. Such an embodiment thereby closes the loop between the paging system and the user, insuring high data integrity.

In a related embodiment, a modem is employed to selectively telephone the paging system and confirm receipt of a paging message. Such a procedure, while overwhelming if practiced generally, is instituted in

response to a series of control bits included with the paging message indicating that the accompanying page is a special one that should be affirmatively acknowledged.

The pager equipped computer may be programmed to respond not to just one paging address, but to a plurality of individual addresses. By such an arrangement, the associated personal computer logs or displays messages addressed to a group of users, such as members of a family or employees of a certain business, instead of just one. In the normal operation a pager only accepts a message if there is a complete match on the entire 32 bit address. By doing a match on less than the entire 32 bits, a pager can be programmed to accept messages directed to an entire group of pagers. Alternately, by providing a pager with additional programming, the pager could be programmed to match a received address against a number of desired addresses and thereby accept messages addressed to anyone of a plurality of ID numbers. With the present system, the capability of receiving messages with more than one ID can be programmed in the pager itself, or it can be programmed in response to commands from the personal computer. Alternately, the pager can send all messages to the personal computer, and the personal computer can screen the messages and only select those with certain ID codes.

In the simplest embodiment, the recipient address decoding function is performed in the pager as described in the referenced patent. However, as an alternative the

pager could send all messages that are received to the personal computer and the address decoding could be performed in the personal computer. The shifting of this processing burden to the computer permits the monitored addresses to be easily modified or updated as users join or leave the group of interest. Irrespective of where the decoding is performed, the pager operation does require an address compare operation in order to make the pager addressable from the central facility.

In a fourth function, the computer may monitor incoming messages for a special symbol that indicates that the associated message is not textual, but rather contains instructions that the computer is to use to control some other apparatus. For example, some computers are presently used to control home appliances, lighting, and heating/air conditioning equipment. The non-textual instructions may be decoded by the computer and cause it to turn on lights, turn down the heat, etc.

The interrupt routine and each of the above-described service routines may be in the form of terminate and stay resident programs (TSRs) loaded into the computer's RAM memory 44 when the computer is booted. Fig. 5 is a map of the computer memory showing these programs.

From the foregoing it will be recognized that the equipping of a computer with a paging receiver provides a number of communication and control capabilities that have not heretofore been available in either the computer

or paging arts. Still further, the combination provides certain benefits beyond those of the communication and control type. One such benefit is the availability of a highly accurate source of time data to the computer. The Gaskill paging system transmits highly accurate time data to each of the paging receivers to synchronize their operation to that of the originating system 12. This data can be used advantageously in unrelated applications to which the computer may be put, including scientific measurement applications in which a precision clock is essential.

Having described and illustrated the principles of our invention with reference to a preferred embodiment thereof, it will be apparent that the invention can be modified in arrangement and detail without departing from such principles. For example, while the invention has been illustrated with reference to a conventional personal computer, it will be recognized that the invention may similarly be applied to portable or notebook computers, thereby further enhancing the invention's utility. Further, it will be recognized that a great number of functions beyond the limited repertoire detailed above may be implemented using the basic pager equipped computer invention.

Finally, it will be recognized that the invention finds applicability with a number of paging systems besides the illustrated Gaskill system. Other paging systems are taught, together with details of other pager instruction

sets, in U.S. Patents 3,166,752, 3,427,633, 3,623,189, 3,647,356, 3,668,528, 3,693,089, 3,742,481, 3,902,022, 3,911,416, 3,980,952, 4,103,286, 4,151,367, 4,160,240, 4,181,893, 4,237,448, 4,247,893, 4,283,796, 4,359,133, 4,370,753, 4,378,551, 4,385,295, 4,398,192, 4,412,217, 4,419,668, 4,438,433, 4,500,961, 4,513,068, 4,521,776, 4,523,332, 4,545,695, 4,578,739, 4,613,859, 4,618,860, 4,618,946, 4,639,726, 4,644,347, 4,644,350, 4,649,538, 4,654,631, 4,661,972, 4,682,148, 4,691,281, 4,701,759, 4,704,740, 4,713,659, 4,718,109, 4,720,710, 4,727,485, 4,734,694, 4,737,978, 4,745,408, 4,754,423, 4,763,244, 4,763,250, 4,766,434, 4,766,537, 4,768,031, 4,769,641, 4,775,998, 4,775,999, 4,779,091, 4,786,902, 4,800,489, 4,804,955, 4,805,097, 4,811,379, 4,812,813, 4,814,763, 4,821,021, 4,823,123, 4,825,193, 4,835,777, 4,839,641, 4,845,485, 4,849,750, 4,851,830, 4,853,688, 4,855,731, 4,857,911, 4,857,915, 4,864,276, 4,866,431, 4,868,558, 4,868,561, 4,868,562, 4,868,563, 4,868,860, 4,870,410, 4,875,038, 4,875,038, 4,875,039, 4,875,039, 4,876,537, 4,876,537, 4,876,538, 4,876,538, 4,878,051, 4,878,051, 4,879,733, 4,880,712, 4,881,073, 4,881,150 and 4,882,579, the disclosures of which are incorporated herein by reference.

In view of the many possible embodiments to which our invention is susceptible, it should be recognized that the detailed embodiment is illustrative only and should not be taken as limiting the scope of our invention. Rather, we claim as our invention all such embodiments as may fall within the scope and spirit of the following

claims and equivalents thereto.

WE CLAIM:

1. A computational and messaging system comprising:

a personal computer, said personal computer including a microprocessor, a memory, a display screen, an I/O interface, and an operating system,

a radio paging receiver adapted to receive paging messages and to produce output data corresponding thereto,

means coupling said paging receiver to said I/O interface in said personal computer,

means for selecting paging messages according to specified critera and for providing said selected messages for further processing,

programming means associated with said personal computer for manipulating, acting upon and displaying data received from said radio paging receiver,

whereby messages can be sent to said personal computer over a radio paging network and operated on by said personal computer.

2. The system recited in claim 1 including,

a paging message clearing house which can be reached by normal telephone, and

means for sending to said computer paging messages telephoned to said pager clearing house.

3. A paging method comprising the steps:

providing a personal computer having a individually addressable paging receiver interfaced thereto;

receiving paging messages addressed to a predetermined recipient;

providing data corresponding to said received paging messages from the paging receiver to the personal computer; and

storing said data in a memory associated with the personal computer.

4. The method of claim 3 which further includes:

providing an interrupt signal to the personal computer from the paging receiver in response to receipt of a paging message addressed to the predetermined recipient;

responding to said interrupt signal by invoking an interrupt routine on a processor integral to the personal computer; and

providing the data corresponding to said received message from the paging receiver to the personal computer in reply to said interrupt routine.

5. The method of claim 3 in which a paging transmitter broadcasts paging messages to a first plurality of recipients and in which the method further includes the steps:

receiving paging messages addressed to a second plurality of predetermined recipients, said second plurality comprising less recipients than the first plurality.

6. A paging method comprising the steps:

providing a personal computer having a paging receiver interfaced thereto;

receiving paging messages addressed to a predetermined recipient;

providing data corresponding to said received paging messages from the paging receiver to the personal computer; and

displaying said data on a display screen associated with the personal computer.

7. The method of claim 6 which further includes:

storing the data in a memory associated with the personal computer;

indicating to the user of the personal computer that a message has been received; and

displaying the data on the display screen in response to a command issued by the user.

8. The method of claim 7 in which the displaying step includes presenting a window on the display screen and displaying the data in said window.

9. The method of claim 5 in which a paging transmitter broadcasts paging messages to a first plurality of recipients and in which the method further includes the steps:

receiving paging messages addressed to a second predetermined plurality of recipients, said second plurality comprising less recipients than the first plurality.

10. A paging system comprising,

a plurality of individually addressable paging receivers in cases with wristwatch form factors,

a personal computer and an individually addressable paging receiver interfaced with said personal computer,

a message clearing house which can receive telephoned messages and transmit said messages to said individually addressable paging receivers,

whereby messages from said clearinghouse can be made to appear either on a wristmounted pager or on the screen of a personal computer.

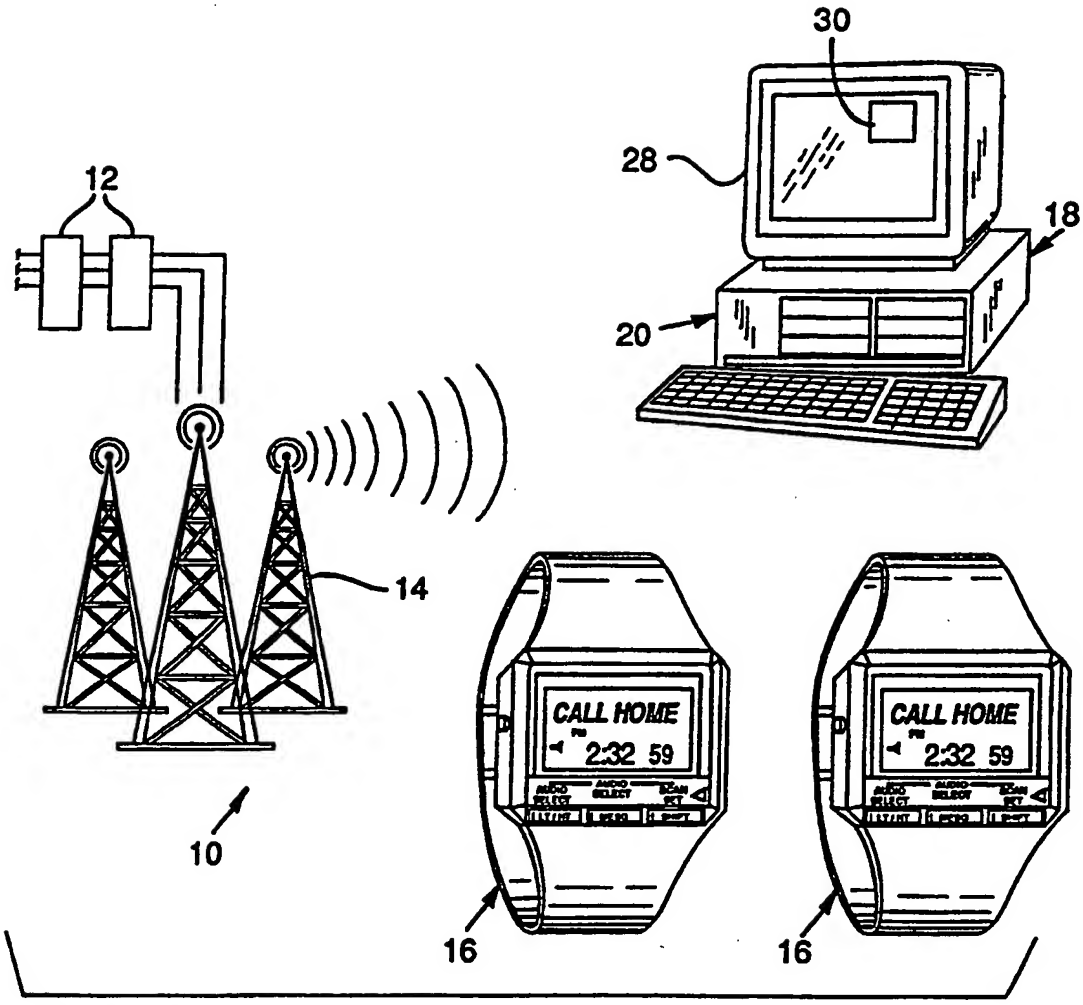

30
28
18
20
12
14
10
16
16
CALL HOME
2:32 59
CALL HOME
2:32 59

FIG. 1

FIG. 1A

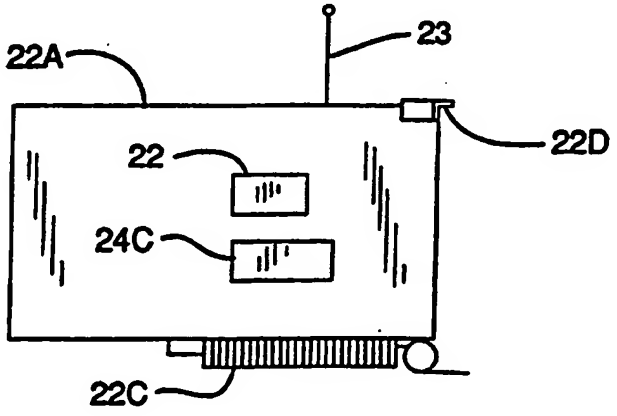

22A
23
22D
22
24C
22C

FIG. 2

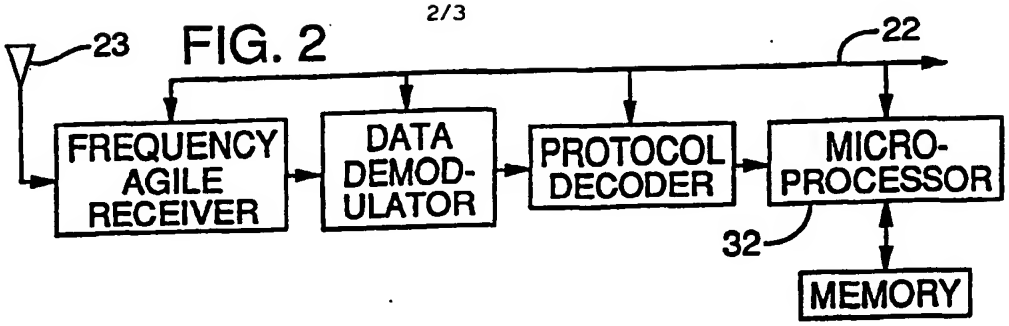


FIG. 3

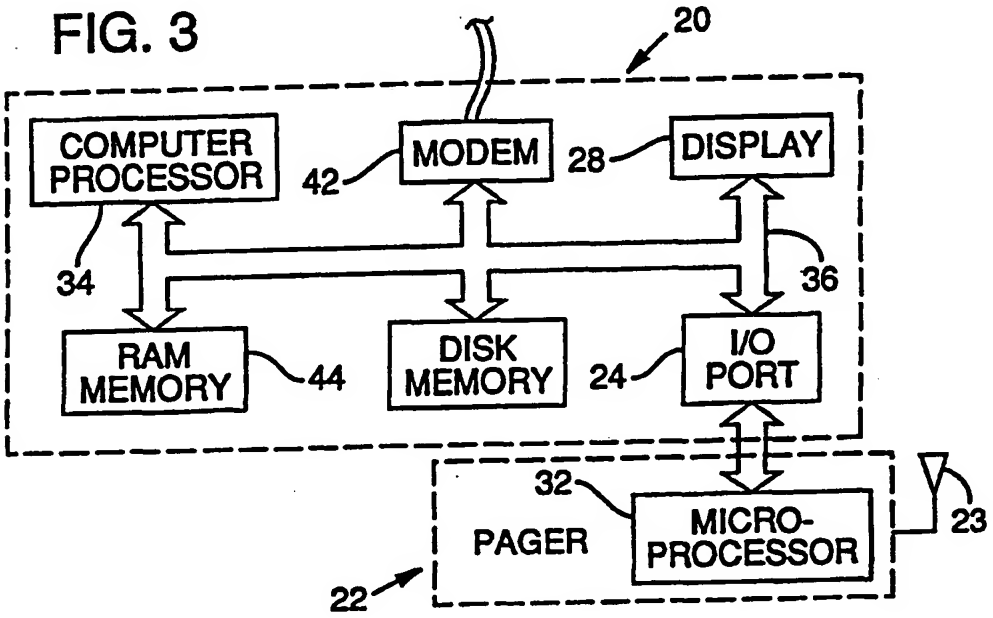


FIG. 5 RAM MEMORY

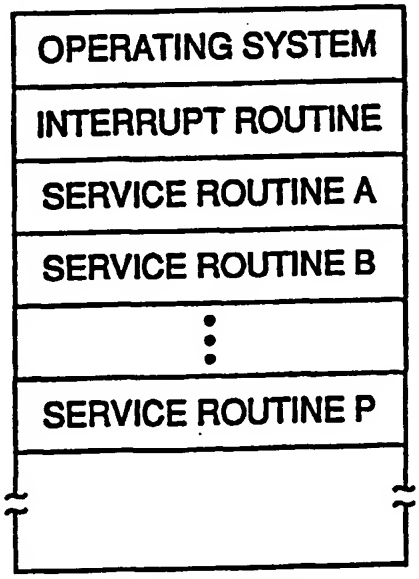
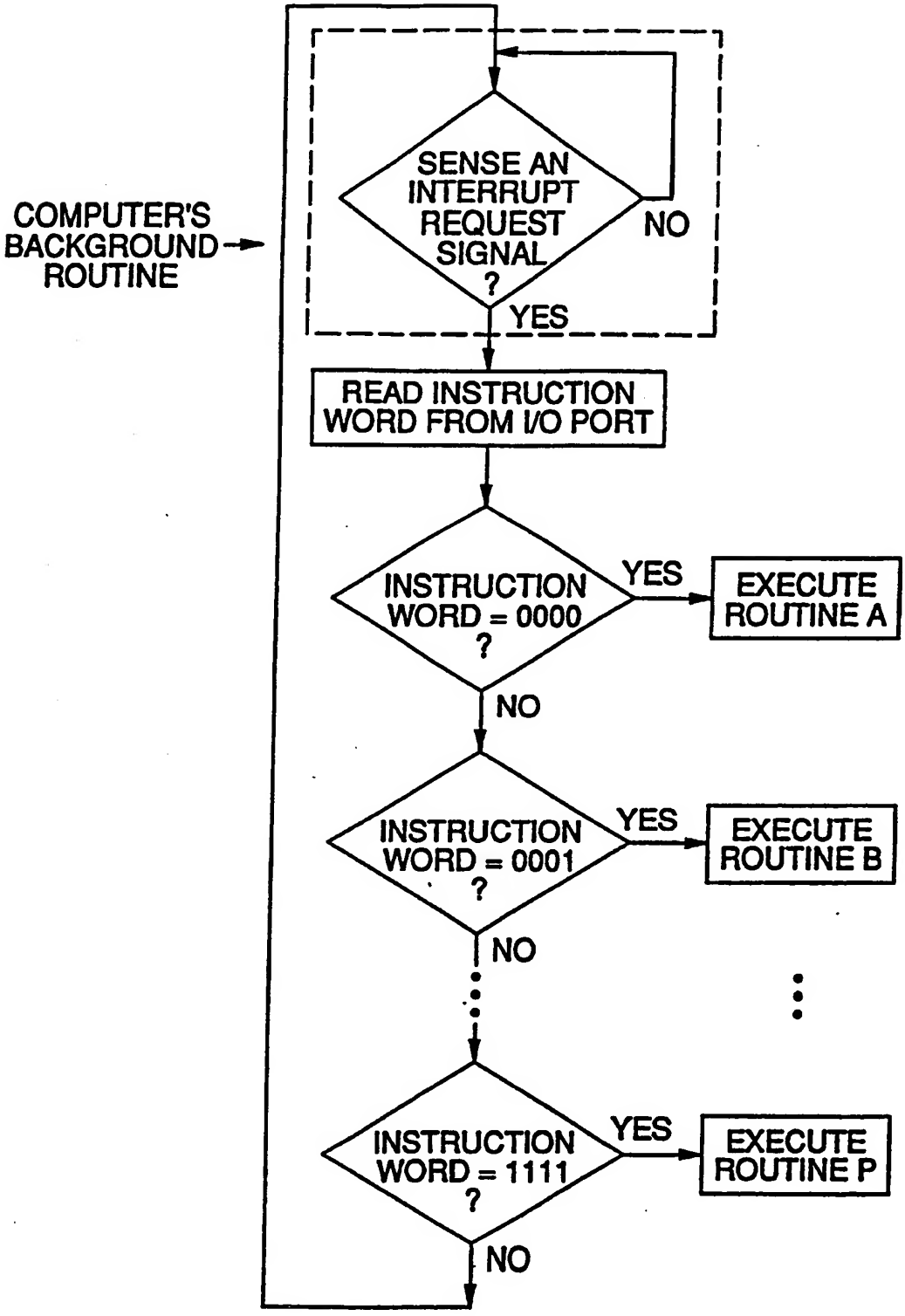


FIG. 4


COMPUTER'S BACKGROUND ROUTINE
SENSE AN INTERRUPT REQUEST SIGNAL ?
NO
YES
READ INSTRUCTION WORD FROM I/O PORT
INSTRUCTION WORD = 0000 ?
YES
EXECUTE ROUTINE A
NO
INSTRUCTION WORD = 0001 ?
YES
EXECUTE ROUTINE B
NO
INSTRUCTION WORD = 1111 ?
YES
EXECUTE ROUTINE P
NO

INTERNATIONAL SEARCH REPORT

International Application No PCT/US91/00731

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC (5): H04Q 7/00; G08B 5/22
U.S. CL: 340/825.44

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System [5]	Classification Symbols
U.S.	340/825.44, 825.47, 311.1 379/56,57,63 358/84 455/31,32,38 364/705.05

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [6]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category * [15]	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
Y	US, A, 3,976,995 (SEBESTYEN) 24 August 1976 See abstract, Figs. 1-3, col.2, line 47-col. 3, line 3.	1-10
Y	US, A, 4,644,351 (ZABARSKY ET AL.) 17 February 1987, See abstract, Fig. 1, 10, col. 4, line 32-col. 5, line 12.	1-10
P,Y	US, A, 4,972,457 (O'SULLIVAN) 20 November 1990, See abstract, figs. 4,6, col. 6, lines 6-11, col. 7, line 7-col. 8, line 8.	1-10
Y	US, A, 4,383,257 (GIALLANZA, ET AL.) 10 May 1983, See fig. 1, col. 1, lines 52-59 col. 3, line 59-col. 6, line 10.	5;9
Y	US, A, 3,937,004 (NATORI, ET AL.) 10 February 1976, See abstract, Fig. 1, col. 1, lines 49-66.	10
A	US, A, 4,806,906 (ODA, ET AL.) 21 February 1989, See asbtract, Fig. 1, col. 1.	1,3,6,10
Y	USA, 4,750,036 (MARTINEZ) 07 JUNE 1988 See abstract, col. 10, line 11, col. 11, line 64, figs. 1,3.	1-10

* Special categories of cited documents: [15]

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [9]

29 APRIL 1991

Date of Mailing of this International Search Report [9]

30 MAY 1991

International Searching Authority [1]

ISA/US

Signature of Authorized Officer [10]

EDWIN C. HOLLOWAY III

Form PCT/ISA/210 (second sheet) (May 1986)